WAA
K69s
1880

KNIGHT

SANITARY IMPROVEMENTS

WAA K69s 1880
0014232
NLM 05147360 8
NATIONAL LIBRARY OF MEDICINE

NATIONAL LIBRARY OF MEDICINE
U.S. Department of Health, Education, and Welfare, Public Health Service
Bethesda, Md.

SANITARY IMPROVEMENT[illegible]

IN THE

VILLAGE OF CAZENOVIA, N. Y.,

WITH REPORTS BY

[illegible] W. KNIGHT, [illegible]

ON THE INTRODUCTION OF WATER AND A SYSTEM OF SEWERA[illegible]

CAZENOVIA, N. Y.
[illegible]
[illegible]

SANITARY IMPROVEMENTS

OF THE

VILLAGE OF CAZENOVIA, N. Y.,

WITH REPORTS OF

CHARLES W. KNIGHT, C. E.,

ON THE INTRODUCTION OF WATER AND A SYSTEM OF SEWERAGE.

CAZENOVIA, N. Y.:
FRED M. TAYLOR. BOOK AND JOB PRINTER.
1880.

WAA
K69s
1880

MUSEUM
OCT 14 1884
OF HYGIENE.

4412

NATIONAL LIBRARY OF MEDICINE
BETHESDA 14, MD.

G 2/18/64

PREFATORY.

At the annual village meeting held on the 18th of March, 1879, the following preamble and resolutions were offered by Mr. D. W. Cameron and unanimously adopted.

Whereas, Men of great medical and scientific knowledge assert that a large proportion of the sickness and disease which preavils in villages and cities, is the result of an entire absence of or imperfect drainage, and

Whereas, Fevers and other diseases, have at times prevailed in this village to an alarming extent, and

Whereas, We have no general system of drainage, but on the contrary every substance, however foul or impure it may be, is generally left to filter through the soil, producing the most deadly and noxious gases, penetrating wells and cellars and thus sowing the seeds of sickness and death; therefore

Resolved, That the incoming Board of Trustees be, and they are hereby instructed to take into consideration, at as early a day as practicable, the necessity and practicability of a thorough system of drainage and such other improvements as shall add to the safeguards of life and health in our village.

Resolved, That as soon as such Board shall be prepared to report thereon, they are requested to call a special meeting of the inhabitants of the village to take action thereon.

Receiving the above as our instructions for proceeding to an investigation of our present sanitary condition, and to present a plan for bettering the same, we caused to be made an inspection of the wells and vaults of some three hundred residences of this village.

Measures were taken to have nuisances removed, so far as was possible, and to the credit of our people, there has been a general willingness to comply with the requirements of the Board. Still there are many wells which should be abandoned as containing dangerous impurities, and there are vaults which should be filled in order to secure greater safety against disease. As time advances these difficulties increase and our soil is each year becoming more and more impregnated with unwholesome matter.

The supply of water from cisterns is also suspicious for drinking and requires great care in its use.

The reports which follow, have been carefully prepared by a competent engineer, whose specialty is hydraulics, and they cover the ground of our needs in a full and comprehensive manner. It is not too early to move in the matter and we have grave apprehensions lest the fevers to which we are subject, become epidemic at no distant day, as the result of impure air we breath and foul water we drink. There is no safety in the feeling that because we have hitherto escaped, we shall be exempt in the future.

Resolute action is urged and we trust the able reports of Mr. Knight, will receive the earnest attention of all our citizens.

ROBERT J. HUBBARD, President.
CHARLES BROWN, }
EBENEZER B. KNOWLTON, } Trustees.
WILLIAM W. WATKINS, }
W. D. WELLS, Clerk of the Board.

Cazenovia October, 1879.

REPORT.

To the President and Board of Trustees of the Village of Cazenovia, N. Y.

GENTLEMEN:—In compliance with your request I have made an examination for the purpose of recommending a suitable source of supply of water for domestic and culinary purposes, and the extinguishment of fires in your village, also such preliminary surveys as were necessary to arrive at a close approximate estimate of cost of such work, including a certain amount of distribution, piping, hydrants, etc., which will be hereinafter detailed. As the result of my investigation, I present the following report, plans and estimate, together with a map of location of street mains, hydrants, gates, etc.

REPORT.

The sources of water from which man derives his supply have but one origin, the snow and rain from the clouds. These descending upon the earth, pass away in floods, are absorbed by vegetation or sink beneath reappearing again in springs and seeping places. These, all in their time, return their waters to the larger bodies, where they are purified and distilled to repeat again their external round. Therefore, fresh fallen rain is the purest of all waters; but in this state it can not be retained in large quantities inexpensively; so that for a public or private supply we are compelled to resort to other sources.

Lakes are, as a rule, the next purest of waters. Although they receive the generally hard water of springs and the turbid waters of floods, there is a filtration and purification of them always in operation whereby the heavier particles are being deposited and the lighter vegetable matter is dissolved into gases, by the action of the sun, which are blown away by the winds.

In making examinations for sources of water, for your village, I endeavored to find a sufficient quantity within a reasonable distance of your town, hoping to be able to recommend for your consideration some feasible plan for a gravity system of works, and for that purpose I visited nearly if not quite every spring and brook within a radius of three and four miles of Cazenovia.

Around Webster's Station I found numerous springs breaking out along the lip of a subterranean reservoir, and was informed that, at the time of my visiting them, August 20th and 28th, they were then at their lowest stages, but recently, Oct. 4th, I found the flow reduced to twenty-four thousand gallons per twenty-four hours. These springs were at a sufficient elevation to give a good fire protection to the main streets of the town and a very economical house service; but would require a large storage reservoir to maintain a supply in drouths. The next waters of any considerable quantity, at a sufficient elevation, were in a branch of the Chittenango creek which was found, however, to be too far away to be considered, since water of better quality and more abundant lay at our feet, limpid and sparkling in the beautiful Cazenovia lake. Whose waters after remaining over a month in a warm room, corked tightly, gave off no odor when shaken, and were as sweet and palatable as when first bottled.

A very serious consideration in determining a source of supply is the relative degree of hardness as it may become a burdensome tax upon the purse, however good otherwise. But I find the lake water at or near the surface as soft as any sample tested.

A few degrees of hardness is said to be preferable for most cooking purposes, and especially in the preparation of tea. The salts prevent the extraction of bitter, herby juices.

Therefore, I turn with pleasure to the consideration of plans for the distribution of its waters throughout your villlage, and I will present the subject by first discussing the quality of water most desirable for a public supply, and follow 2nd, Quantity required—3rd, Description of plans proposed—4th, Estimate of cost—5th. Expenses and revenue—6th, Conclusions each in their turn briefly.

Before proceeding, however, let me thank the President of your village for his kindness and many gentlemanly considerations, also the Members of the Board, Prof. Clarke and others for their willing and pleasant assistance.

QUALITY OF WATER.

With regard to sources and quality of water most desirable, I will give you mainly the opinions of those whose writings upon this subject are considered as authority. First, quoting from the "Report upon the Sanitary Chemistry of Waters" by C. F. Chandler, President of the New York Board of Health.

"Water being a great solvent, dissolves to some extent whatever it comes into contact with. Even atmospheric waters, the rain and melted snow are not pure. Rain as it falls through the air washes out the solid particles of dust and the germs of animals and plants.

"Water which is collected from roofs in the city is never pure. Rain water almost always contains a little organic matter causing it to become putrid when kept for some time.

"Terrestrial waters are always impure. Rain falling upon the earth's surface is absorbed by the porous soil, and the material of which the soil is composed, being to a greater or less extent soluble, the water becomes contaminated with mineral matter. The character of spring water therefore depends upon the character of the soil through which it has passed.

"Spring water is generally very clear although it may be very impure. The soil through which it has passed, although it has conferred upon it its impurities, has at the same time filtered it and rendered it clear and sparkling."

"Ordinary open wells are supplied partly by springs and partly by surface drainage. The water usually contains the alkaline and alkaline earthy salts of spring waters. In the neighborhood of dwellings the proportion of chloride of sodium is generally increased by the drainage of house refuse, which also leads to the contamination of the water with the products of the decomposition of animal matters, such as salts of ammonia, nitrites and nitrates.

"In many cases from the proximity of cesspools and privy vaults the water becomes contaminated with filtered sewage matters, which, while they hardly affect the taste or smell of the water, have, nevertheless, the power to create the most deadly disturbances in persons who use the water.

"Pond, lake and river waters although containing the same mineral impurities are generally purer than spring water, for the reason that while these bodies of water receive the waters of springs they also receive a considerable quantity of water which has simply run over the surface of the earth. For this reason the waters of ponds and lakes are much purer than those of the springs in the same locality. Rivers and creeks are more likely to be charged with suspended impurities for the reason that their waters which have not been filtered through the soil, carry with them a certain quantity of mud and organic matter.

"The characteristics of a good drinking water may be enumerated as follows: "The temperature should be at least 10 degrees lower than the atmosphere, but should not be much lower than forty-five degrees Fahrenheit.

"It should be free from taste, except perhaps a slight pungency from oxygen and carbonic acid, which is an advantage. Taste however is a poor guide. When one becomes accustomed to a certain water, that which is pure tastes flat by comparison.

"A third requirement is freedom from smell. This should not be apparent even when a bottle half filled is placed in a warm room for a few hours and then shaken. It should be transparent, not that it is necessarily poisonous if not transparent, but it is preferable to take our solid food in some other form."

The eminent French author, Gaston Tissandier, says that "water may be considered good when it is fresh, limpid, inodorous, not inclined to become turbid when boiled, when it leaves but little settlement after evaporation, when its taste is sweet and pleasant, and neither salt or insipid, when it dissolves soap easily without forming clots, and when it boils vegetables well.

"Rain water when first collected is not indeed absolutely pure, but it is the purest to be found in nature. It has, however, the defect of not holding any calcareous matter in solution, of not being nutritious and of not containing sufficient air in solution; hence it is insipid and of a sickly sweet taste.

"Cistern water does not answer these requirements (referring to those he states, for good water) for the rain which trickles down the roofs of houses carries along with it organic and mineral substances. It is true that this matter chiefly sinks to the bottom and the water becomes, comparatively, pure after resting a few days; but it may be changed again by the decomposition of the organic matter which takes up and carries away the oxygen it contains, and this leaves only an insipid, disagreeable and highly deleterious liquid."

Briefly stated, purity, softness and limpidity are the requirements for good potable and domestic water and that the experience of other communities will sustain the statement that well-water is the most impure of all water ever used, in old and closely settled towns, and that stored cistern-water is the next most impure. Wells are mainly but the interception of soakage lines and surface drainage, usually varying in depth of water with the seasons of drouth and humidity. This capacity can usually be readily estimated from the topography of the surface.

The water collected in them is, however, generally limpid, cool and sparkling, having a certain flavor contributed by the chemical union of impurities, which, becoming accustomed to, is grateful to the taste, and persons will go a long distance to procure them for their fine flavor. Yet they contain an active, and frequently germs of a deadly poison subtle, but sure in its effects. Says Prof. Chandler, "Many diseases of the most fatal character are now traced to the use of water poisoned with the soakage from soils charged with sewage and excremental matter. Sudden out-breaks of diseases of a dysenteric character are often caused by an irruption of sewage into wells, or from some peculiarity of the season. Such contamination of the water is not indicated by any perceptible change in the appearance of the water. The filtered sewage, clear and transparent, carries with it the germs of the disease."

At a convent in Munich, thirty-one out of one hundred and twenty-one of the inmates were affected with typhoid fever, from the pollution of the wells by sewage.

In a boarding school for young ladies in Pitsfield, Mass., the typhoid fever broke out from the use of water contaminated by leakage from a cesspool.

In the town of Rome four families, consisting of twenty-seven members, sixteen of them were prostrated with typhoid fever during one month. These families drew their water from separate wells but were similarly situated and contaminated with the fatal germs.

It is conceded now to be a fact that typhoid fever is caused by the poisoning of water by animal refuse, and I mention the above few cases among the thousands which have been traced directly to this source, as an illustration of what, at no distant day, may be your experience; serving to bring more vividly to mind a warning never to soon heeded.

I understand that some of your citizens use stored cistern water for table use, and I presume they are careful to conduct only the water which falls during the latter part of a rain storm into their cisterns and to ventilate them properly and, to introduce ice when the water is drawn, to disguise its repugnant and insipid taste.

The purer water is, the more greedily does it seize upon gases and impurities in the air, so abundant over thickly settled towns, and the rain as it descends absorbs rapidly the dust and soot upon the roofs and the decaying woody fibre and metalic oxides. Certainly most of this foreign matter settles or floats upon the surface after a few days or hours of quiescence; but that such water is very impure is evident from the rapid production of animalculae, showing the abundant presence of the food necessary to maintain that minute but vast quantity of animal life. A carcas teems with animal life for the same reason.

Cistern water not ventilated, often becomes very offensive owing to the gases which are thrown off after the water has dissolved the vegetable and animal matter it has absorbed.

Carbon filters certainly purify the water drawn through them for a short time; but from experiments made in England it has been shown that such filters only act for a short period as purifiers, afterwards they simply filter the water imperfectly.

QUANTITY OF WATER REQUIRED.

In selecting a source of supply, it is important to consider the various wants of a community to be supplied.

In large or in rapid growing places it has been customary to provide for at least twice their present population, based on the quantity actually furnished to each inhabitant in places of similar requirements, also at a season of the year when the demand is the greatest and the supply at its least.

Formerly, American engineers based their calculations upon quantities allowed for European cities. Their wants as stated by Prof. Rankine per inhabitant, in England, are as follows, which is a fair allowance:

Uses.	Imperial Gallons per day. Least.	Av.	Most.
For domestic purposes,	7	10	15
" Washing streets, extinguising, fires, fountains etc.	3	3	3
" Trade and manufacture,	7	7	7
" Waste under careful regulation,	2	2	2.5
	19	22	27.5

This quantity has been found entirely inadequate for American cities. Below is a table of the quantities per capita used by some of our cities and villages.

Boston,	74
Brooklyn,	63
Rome, N. Y.,	59
Philadelphia,	58
Cincinnati,	57
Cambridge,	55
Albany,	50
Canajoharie, N. Y.,	48
Providence,	38
Fall River,	37
Rochester,	35
Lynn,	34
Lowell	33
Louisville,	29
Newark,	20

In some of our cities like New York, Chicago and Washington the rate is much higher.

The variable quantities represented in the foregoing table is owing mainly to the location and varied wants of the places named. Seaports and manufacturing towns, as a rule, use the most water. Also as cities increase in size, there is more than a corresponding increase in the quantity used, owing in part to the introduction of modern improvements in buildings, but mainly to its use in manufacturing purposes and a considerable percentage to *leakage of old and faulty pipes and want of proper care in construction.

*In the annual report of the Boston Water Works' Board for 1878 they give the hourly consumption for several days in percentage of the average daily consumption and it was discovered that from midnight to 4 A. M. it amounted to 94 per cent. of the hourly average. During these hours the consumption for proper purposes is comparatively light, showing leakage and unnecessary waste.

After a careful consideration of the subject with reference to present wants and possible future requirements one hundred thousand gallons per day or about sixty gallons per capita, for your present population, has been deemed a sufficient quantity for the maximum allowance, and with the works so located and constructed that this quantity may be doubled if necessary without sacrificing your construction of the near future to possibly more remote enlargements or requirements.

The next question which requires consideration is one which arises from the fact that the consumption during certain hours of the day is large while at others it is proportionately small.

If you pump by steam, a reserve of power to meet the maximum demands must be always maintained, consequently a loss of fuel is sustained; or pumping by water power it would require extra cost for a regulating device, and more manual labor. Also we must take into account the demands in case of emergencies, such as fires. For economy of maintainence therefore, some storage of water is absolutely necessary and our reservoir must be in some measure proportionate to our population. In small cities and villages the variation in the quantity of water required between the man and the extreme of hot and cold weather is generally slight compared to large cities. In the city of Rome, N. Y., it amounted to but two and one-half gallons per capita or equivolent to

an increase of, for	January,	1877,	....	.042 per cent.
Brooklyn, "	"	"	....	.13 " "
Philadelphia, "	July,	"	....	.17 " "
Chicago, "	"	"	....	.07 " "

DESCRIPTION OF PLANS.

PIPING.

Upon the map, accompanying this report, I have located a certain amount of distribution pipes, with the necessary valves and specials and so distributed the hydrants as to give the best fire protection. From its inspection you can ascertain all you will care to know upon this subject, making further description unnecessary.

In my estimate I have provided for one blow off into the creek at Albany St., and for crossing through the creeks instead of over, as is too frequently done. Also for extra specials, for all street intersections where crossed, not included in the following list of streets estimated for piping:

Location.	Size.	No. feet.	Total feet.
From Reservoir to Nickerson St.	10 in	400	400
Albany from Forman to creek	8	2,400	
Sullivan " Albany to 10 in. main	"	2,750	
Lincklaen " " " Seminary	"	410	5,560
Nickerson " Lincklaen to Sullivan	6	760	
Mill " Albany to Creek	"	750	
Lincklaen " Seminary 1,800 ft. north	6	1,800	
Farnham " Albany to 400 ft. north of William	"	1,300	
Nelson " Albany east	"	1,300	
Fenner " Nelson "	"	800	5,710
Forman to junc. of Lake and De Ruyter	4	980	
Liberty Street	"	440	
Seminary "	"	530	
Chenango from creek south	"	620	
Lincklaen " 1,800 ft. N. of Seminary St., N.	"	470	
Center Street	"	600	
Farnham from 400 ft. N. of William to Swetland	"	480	
Nelson " 1,300 ft. east of Albany E.	"	600	
Fenner " 800 " " " Nelson "	"	440	5,160
			17,830

RESERVOIR.

A reservoir of several times the capacity of the one I have estimated would be desirable, yet, for economic and other reasons, I advise the construction of a small one made of iron and wholly inclosed.

My estimate is for one of two hundred thousand gallons capacity, located on the hill in the north part of the village, giving a total elevation above the lake of one hundred and eighty feet. This quantity of water stored against accidents seems small indeed; however, it will supply three ¾ inch fire streams for over ten hours duration, with the pumps idle, or double that number for eight hours with their ordinary speed. This quantity will, for ordinary consumption on the district proposed to be piped, which is nearly the whole town, supply you for three days when bathing pans and water closets have been generally adopted, but for some years will give an ample supply for at least four days, a time sufficient to repair or replace injured or broken parts of machinery, with duplicates on hand.

My estimate is for a reservoir of the following dimensions and construction. A tank forty feet diameter and twenty-four feet high with a pine plank bottom, resting upon a foundation of concrete, the latter is used in quantity sufficient to simply form a level bed upon the rock. The sides will be made of thin plates of wrought iron, ranging from No. 6, American gauge at the bottom, to No. 16 at the top, lap jointed, rivited and corked supported by light angle irons. For a covering and a protection from heat and cold alike, I estimated on a building fifty feet external diameter, leaving a space of about three and one-half feet between the inner circumfrence and the sides of the tank, with walls of brick one foot thick, surmounted with a conic slate roof, and ventilator supported by a light Fink truss.. The building is to be lighted by four glazed and grated openings five feet from the ground, and, each one foot six inches wide by six feet high. The estimate covers one flight of stairs, cementing the floor, furring and plastering the inner surface of the wall, also the insertion of one double door three and one-half feet wide by eight feet high and coating the tank inside and out to preclude rust.

STEAM PUMPING STATION.

The engine and boiler house is designed to be of brick, twenty four by thirty feet, with walls one foot thick and sixteen feet high, covered with a slated roof, with a light O. G. galvanized iron cornice running around the eaves. The roof will be a rectangler hip constructed of wood, boarded with matched lumber. It is designed to have five windows, two feet four inches by seven feet four inches, and three doors, two outside, four by nine feet, and one inside, three by eight feet. The engine room will be separateed from the boiler room by an eight inch brick wall and timbered and floored under foot and ceiled over head. The boiler room will be twelve by twenty-two feet, with flagging for floor and no ceiling. The stack will have an eighteen inch square flue and sixty feet high.

All of the brick work is estimated plain, first-class work, except under the iron cornice where it will be arranged to form a belting course and lines of dental work and also recessed at the doors and windows.

The pump well is designed to be eight feet diameter and ten feet deep, with walls one foot thick. It will be roofed and protected from the weather.

The engine, pump and boiler estimated are for an engine seven by twelve inch cylinder, running at a minimun piston speed of one hundred and fifty feet per minute and a maximum of three hundred feet per minute, cutting off at half stroke, with a steam pressure of sixty pounds. The pumps are double acting horizontal pumps, ten by sixteen inch cylinder, with eight inch suction and six inch delivery pipe, ordinarily running sixteen revolutions per minute. The boiler is a three by nine foot return tubular with thirty-two two and one half inch flues.

WATER POWER PUMPING STATION.

The water power pumping station house estimated is for a building sixteen by twenty-two, by twelve feet high, and constructed in the same manner and of the same material as estimated for the steam pumping station, with these exceptions: It will have three windows, one door and a chimney, the inner wall will be wainscoted, lath and plastered throughout, and the pump well will be located inside of the pump house. The pumps will also be of similar construction.

The power required at the steam pumping station to elevate one hundred thousand gallons in ten hours, through a six inch main, eighteen hundred feet long, to an elevation of one hundred and eighty feet, is 7.82 H. P. At the water power station to perform the same work with the increased lift required is 8.2 H. P.

The engine, pump and reservoir house are estimated for first-class workmanship, the engines and boiler the same. The pumps are extra heavy slow motion pumps, durability and economy of maintenance being the controlling motive in all of my designs and estimates.

ESTIMATE OF COST.

The main objects of a water supply are to furnish the people with pure and wholesome water for domestic purposes and for a general fire protection, therefore, every citizen has a right to demand that he shall share in these blessings. But it is very evident that this reasoning may carry us to extremes, as there are isolated houses to which it would be practicably impossible (in a financial sense) to extend the system.

In Rome, N. Y., there is of the distribution proper about one mile of pipe to each one thousand inhabitants. In Canajoharie, N. Y., one mile per one thousand inhabitants. The average of our principal American cities is nine-tenths of a mile per one thousand inhabitants. The quantity proposed for Cazenovia, per one thousand inhabitants, is over one and nine-tenths miles.

This quantity might be reduced one quarter, still giving you an ample fire protection; however, I have estimated upon the distribution as shown upon the map as follows:

DISTRIBUTION.

256 tons of piping laid complete	$12,500 00
6 double, 25 single hydrants set complete	1,250 00
1-10, 5-8, 9-6, and 5-4 valves " "	560 00
12,000 lbs. specials laid complete	540 00
Total distribution	14,850 00

RESERVOIR AND HOUSE.

Rock and earth excavation, foundations and tank complete	$1,200 00
Reservoir house complete	1,500 00
	2,700 00

STEAM PUMPING STATION.

Engine and boiler house, stack and foundations complete	$ 840 00
Pump well, screens, etc	220 00
Force main suction pipe and gate	910 00
Engine, pump, boiler and foundations	1,350 00
	3,320 00

WATER POWER PUMPING STATION.

Pump house and foundations complete	$ 360 00
Pump well and screens	180 00
Force main 500 ft. suction 12 ft. one gate	350 00
Pump and connections and foundations	680 00
	1,570 00

SUMMARY OF COST.

Distribution	$14,850 00
Reservoir and house	2,700 00
Steam pumping station	3,320 00
Engineering and superintendance	2,000 00
Total cost pumping by steam power	22,870 00
Difference between steam and water power	1,750 00
Total cost pumping by water power	21,220 00

I have carefully estimated all of the work in detail and I believe that the above amounts will cover the total cost of construction at the present prices of labor and material.

To bring the water direct from the lake, in vitrified pipes to the water power pumping station, would cost two thousand dollars for pipe, inlet-chamber, screens, gates and stand pipe.

In the above estimate no provision has been made for land, damage or right of way, which for certain reasons has been omitted.

EXPENSES AND REVENUE.

EXPENSES.

The variation in the expense of raising water is very great, ranging from seven to twenty cents per million gallons, raised one foot high. The latter is nearly what I estimate your running expences to be if you pump by steam power. You will of necessity keep one man in constant attendance, but the consumption of coal, oil, etc., need not by careful management exceed the average, yet your rate of expense will be high.

I estimate the annual cost of running by steam as follows:

One engineer per annum	$400.00
Coal consumed to deliver 100,000 gallons per day into reservoir, 156 tons,	546.00
Repairs to machinery	25.00
Oil, tallow, waste, etc	20.00
	991.00
Superintendance and collection of rents	200.00

Making a total yearly expense of twelve hundred dollars in round numbers.

After the first year the repairs to the distribution are nominal.

The cost of raising one million gallons one foot high by water power, that is the running expenses, falls under two cents or about one-fourth of the maximum cost of steam power. This however will be somewhat increased in your case; not being able to secure the water privilege or a portion of it, but must attach to wheels already in use. In Oswego, Cohoes and other places, the charge per horse power is about five dollars per annum. This includes in some cases the rental of grounds but no machinery. In my estimate, however, I have allowed double the above price per horse power and for pumping by water power will be as follows:

8 horse power per annum $10	$ 80.00
Attendance upon pumps	160.00
Oil, tallow, repairs, etc	20.00
	260.00
Superintendance, collection of rents, etc	200.00
Total annual expense	460.00

The estimate for pumps is for heavy and strong, slow motion pumps, not liable to accident and will not need attendance for several consecutive hours and may be run during the night. By using the water power during those hours of the day you may be able to reduce the running expenses something below the estimate.

The ultimate renewal of all machinery or its equivalent, occurs in periods depending upon its construction and uses for their length or the "life time of a machine," as it is termed, and in the steam pumping plan, it will add four per cent., equal to forty-eight dollars, and to the water power plan, about five and one-half per cent. or twenty-five dollars to the total annual expenses.

REVENUE.

The receipts per mile of distribution in cities, vary from $740.00 in Rome, on the city distribution, up to over $3,000.00 in Boston, Mass. We usually estimate $1,000.00 per mile of distribution. Assuming your water rents to be one half that amount, and three and three-tenths miles of piping will be $1,600.00. By actual count you will have over 330 takers and three hotels; assume now, to be within safe limits, that one half of these use the water at an average rate of $9.00 each.

165 takers, $9.00	$1,485.00
1 hotel	50.00
2 "	60.00
	1,595.00

(The average rate paid per taker in Canajoharie is over $10.00 per annum; while in cities it ranges much higher.)

Many cities and villages grant the privilege to private corporations to supply them with water, and contract to pay so much per hydrant for fire protection. The prices generally varying between $50.00 and $75.00 per hydrant per annum.

Toronto pays at the rate of $336.00 per mile of piping for the use of fire hydrants, and $177.00 per mile for other city purposes. Lynn, Mass., pays $200.00 per mile for use of hydrants. Fall River, Mass., pays $417.00 per mile for use of hydrants and for public buildings.

The same cities pay in proportion to their number of inhabitants as follows:

Toronto, for use of hydrants, per capita	$0.50
Lynn, " " " "	0.30
Fall River, " " " "	0.44

You will notice that my tables and inferences, not only in this case, but throughout this report, are taken generally from reports made by towns much larger than Cazenovia. We are unfortunate in this respect, in not having water-works statistics from villages, as it will lead many to erroneous conclusions.

In small towns the remuneration per capita should be proportionately greater than in cities; but perhaps not quite as the ratio of inhabitants per hydrant or per mile.

I will give one more illustration of the value of a water supply to the community as a whole, and which might be termed the hydrant tax, which is in the reduction of insurance rates.

A general insurance agent at Gloversville, says, "of the total reduction of rates, since the construction of their works, that it is equal to 33 per cent. of their present rates, due to the better fire protection." Whether his conclusions are correct or not, the construction of water-works is a direct relief, to some extent, by reducing the rates, and would probably range between 5 and 10 per cent. less than the premiums now paid by you.

I submit the following estimate of your annual income which does not inculde returns from engines, railroads, manufacturies, or its value for street sprinkling, as follows:

For house service	$1,600.00
* " 31 hydrants per annum	1,000.00
Total income	2,600.0

* Schenectady, when a city of 10,000 inhabitants, paid for the use of hydrants, per annum, when their works were first constructed, $10,000.00.

The income of the Fall River water-works is $132.60 per million gallons consumed, with an average of 500 gallons per service. In Cambridge the consumption in gallons per capita is 55, the consumption per service is 378 gallons, the receipts per million gallons consumed are $161.10.

It will not be many years before you will use the 100,000 gallons estimated for your daily requirement, or 36½ million gallons per annum.

I have introduced the few foregoing comparative statistics so that you may draw your own inference and calculate your probable present and future income.

By not burdening you with any conclusions of mine, I trust it will lead you to investigations of the subject more satisfactory to you, and in which you will have more confidence than results presented by me.

In conclusion, I would say, that the expense of any individual system of water supply, is greater than by a properly construced public system. and that as your immunity from conflagrations is increased, your insurance rates would be diminished, and that with judicious management your works in a short time will become self-sustaining.

Although your amount of piping is very large, in proportion to your inhabitants, the cost of your works, as contemplated. is considerably below the average cost per capita in cities throughout the United States.

Respectfully submitted,

Rome, N. Y., Oct. 9th, 1879. CHAS. W. KNIGHT, C. E.

To the President and Board of Trustees of the Village of Cazenovia, N. Y.

GENTLEMEN:—Rightly understanding the importance of sanitary measures and anticipating the wants of advanced civilization, also comprehending the highest interests of your town, you have decided to exercise that power conferred upon you as a community, to secure or improve the state of public health by the construction of water works, and the general drainage and sewerage of your village.

The foregoing report and estimate for a water supply and the following for sewers are submitted as requested.

In the latter as in the former investigations, surveys were made sufficient to locate and proportion the relative sizes of sewers, etc., for the work required.

REPORT.

Wherever masses of people congregate, whether in cities or villages an artificial existance obtains, so that individuals are no longer independent in their habits and position, but are influenced by those around them. Therefore the preservation of the health of all classes is important. Important to the wealthy, as infectious diseases are no respecter of persons, attacking the high and the low alike, but are most frequently contracted among those not able to maintain a proper condition of cleanliness about them. Important to the poor, as his health is his wealth.

Pure air, pure water and nutritious food are the three great promoters of life and health. Air loaded with decomposing matter will not sustain life in health, as it lowers the natural vitality and renders the human subject more susceptible to disease. Water conveys nutrition throughout the animal system and then becomes the vehicle for carrying away all substances that have served their purpose in the animal economy. Food supplies the daily loss and waste, and to take the place of those substances passed away as excretions.

It has been so provided in nature that when these substances have subserved their purpose in the animal kingdom that they shall be changed, by decomposition, liberating gases which are absorbed by vegetation, leaving portions to unite with mineral constituents of the earth, thus becoming again fit to sustain life in the animal creation. This change takes place in all things and man only suffers for the delay. The excretions and other waste from the animal system when retained in places of deposit, in time putrify throwing off putrescent gases, food for plant life; but often containing germs of disease to the human system.

The refuse of all kinds from or about the human creature, when conveyed direct to the fields or streams, does not putrify, but is speedily changed, becoming food for plant and aquatic life.

These considerations render it obligatory upon municipal authorities to institute some sanitary measures for the preservation of health and life.

"To preserve health is a moral and religious duty. For health is the basis of all social virtues. We can be useful no longer than we are well."

DESCRIPTION OF PLANS.

The topogarphy of the surface of the ground in towns often defines the only practical outlet for the sewers; making it in many cases, as in yours, impossible to equally distribute the necessary outlay. Yet these differences may in some instances be diminished by the introduction of intercepting outfalls, thus conveying the sewage in one direction or to one point, and the storm-water to another; accomplishing all that is desirable in the removal of facael and putrescent matter where it will not be harmful, yet diverting the flood-water of severe storms to a nearer outlet; thus materially reducing the expense of the main outfall sewers.

Upon the map accompanying this report are located the sewers for the streets suggested, also their outfall sewers, and for convenience of reference I will designate the district by the name of the street where the outlet occurs as follows:

The Chenango Street Outfall will empty into the Chittenango creek about 300 feet below that street and drains simply that street and the surrounding grounds, and will be constructed as follows:

4 00 ft. of 8 inch pipe; 300 ft. of 6 inch pipe; 4 street basins with their necessary traps, hand holes, bends and connections; 2 ventilators and connections; 6 house connections.

MILL STREET OUTFALL.

Mill street outfall empties into the Chittenango creek below the dam at Mill street, and is intended to convey the sewage from Forman, Hurd, Seminary and Mill streets; Albany street from the Lake to within 75 feet of Lincklaen street; Nickerson from Forman to Sullivan and Sullivan from Albany to Nickerson street, and the storm water from the same district excepting Forman, Hurd and Nickerson streets which will be conveyed by intercepting sewers to the lake, and constructed as follows:

1350	ft.	of	18	inch		from	outlet	to	Albany St.	at	Hurd St.
150	"	"	8	"	Mill St.	from	outfall sewer	to	South		"
500	"	"	6	"	"	"	"	South	to	Albany	"
550	"	"	8	"	Albany	"	"	Forman	"	Hurd	"
510	"	"	10	"	"	"	"	Hurd	"	Sullivan	"
450	"	"	8	"	"	"	"	Sullivan	"	75 of Linck.	"
450	"	"	10	"	Sul'van	"	"	Albany	"	Seminary	"
620	"	"	8	"	"	"	"	Seminary	"	Nickerson	"

19 street basins complete; 9 ventilators; 7 man holes; 80 house connections.

ALBANY STREET OUTFALL.

This outfall discharges into the Chittenango creek 300 ft. below the Albany street bridge, and is estimated to convey the sewage and storm-water of Albany street from the creek to 75 ft. west of Lincklaen street; Lincklaen street from Albany to Seminary street; Center street and Farnham from Albany to William street, and constructed of

500	ft.	of	18	inch	Albany	St.	and creek to Farnham street.
150	"	"	10	"	"	"	from Farnham to Center "
550	"	"	8	"	"	"	from Center to 75 west of Linck. "
400	"	"	8	"	Lincklaen		from Albany to Seminary
630	"	"	9	"	Center	"	" " " Lyman St.
440	"	"	10	"	Farnham	"	from Albany to angle in Farnham St.
200	"	"	8	"	"	"	" angle to 200 ft. north.
280	"	"	6	"	"	"	" 200 ft. N. of angle to William St.

18 street basins, 7 ventilators, 5 man holes, 91 house connections.

WILLIAM STREET OUTFALL.

The outfall of this district empties into the Chittenango creek at William street bridge, and is proportioned to carry the sewage and storm-water of Farnham street, from William to summit 275 feet north of William St.; Lincklaen street from Seminary to Factory St.; Sullivan from Nickerson street to summit of Blair's hill, and constructed of

1020	ft.	of	18	inch.,	William street,	from	creek to Lincklaen street.
280	"	"	6	"	Farnham "	"	William " 280 ft. north.
700	"	"	15	"	Lincklaen "	"	" " 700 " "
500	"	"	12	"	" "	"	700 ft. N. of William to Factory St.
130	"	"	18	"	" "	"	William street to Nickerson "
560	"	"	9	"	" "	"	Nickerson " " Seminary "
770	"	"	15	"	Nickerson "	"	Lincklaen " " Sullivan "
150	"	"	12	"	Sullivan "	"	Nickerson " " 150 ft. north.
470	"	"	10	"	" "	"	150 ft. N. of Nickerson St. to 150 ft. north of Union street.
275	"	"	8	"	" "	"	150 ft. N. to 425 ft. N. of Union St.

28 street basins, 11 ventilators, 6 man holes, 116 house connections.

ESTIMATE.

The following estimate provides for sewers proportioned to carry 45-100 of a cubic foot of sewage per capita per hour for the probable future population of each district, and 6-10 of one inch rain fall per hour for the whole area of each district without inconvenience to any house.

The custom formerly prevailed, and it is the opinion of many now, that sewers can scarcely be made too large. Therefore many of these constructions of the past are simply sewers of deposit, requiring an enormous expenditure to keep them clean; and, instead of health preserving, were really the source of many outbreaks of filth diseases, owing to the putrifaction and rapid accumulation of the sewer gasses. Experience has shown that sewers, adjusted to the work required of them, are self-cleaning.

The estimate provides for all—curved connections; for masonry street-basins with flagging, top and bottom; and vertical grating to inlet; masonry manholes, with iron covers; pipe ventilators, and pipe hand-holes to traps; and, for the district proposed to be sewered, are as follows:

C NANGO STREET OUTFALL.

Sewer and house connections laid,	complete,	$ 260.00
Street basins, ventilators, etc.,	"	104.00
Engineering and superintendence,		44.00
		$ 408.00

MILL STREET OUTFALL.

Sewers and house connections laid,	complete,	$2870.00
Street basins, ventilators, etc.,	"	619.00
Engineering and superintendence		428.00
		$3917.00

ALBANY STREET OUTFALL.

Sewers and house connections laid,	complete,	$1730.00
Street basins, ventilators, etc.,	"	510.00
Engineering and superintendence,		268.00
		$2508.00

WILLIAM STREET OUTFALL.

Sewers and house connections laid,	complete,	$3543.00
Street basins, ventilators, etc.,	"	811.00
Engineering and superintendence,		522.00
		$4876.00

The street frontage of the Chenango street outfall is about 1,000 feet, making the cost about 41 cents per lineal foot of street front.

The street frontage of the Mill street outfall, upon the line of the sewer, is 7,200 feet, and the frontage indirectly benefited, includes that of Seminary, Hurd, Forman, and a portion of Nickerson street, making the cost, if properly equalized, about 45 cents per lineal foot of street front.

The street frontage of the Albany street outfall is about 6,100 feet, making the cost 41 cents per lineal foot of street front.

The street frontage of the William street outfall is about 9,500 feet of street front on the line of the sewers, and the frontage indirectly benefited, are those of Liberty and Union and the upper portion of Sullivan street, which should leave the rate about 45 cents per lineal foot of street frontage.

All of the above work has been estimated carefully in detail, and the amounts stated, will cover every item of expense, connected therewith, for first class work and material.

Should you consent to use Portland cement pipe, it will reduce the cost about 3 cents per foot of piping, or, 1½ cents per foot of the frontage.

The expense of maintaining a properly constructed system of sewers in your village will be light, consisting, mainly, in the occasional flushing of the street basin traps and the upper ends of the small sewers, which can be quickly accomplished, direct from your hydrants.

There is a money value to every town by sanitary improvements that the people at large seldom or never consider, viz: in the reduction of the death rate and sickness, and, consequently, a real money value for lives saved; and, diminished expenses for care of sick; also, the town as a whole, reducing the number of paupers. The effect upon all towns is not the same, but it very noticeable in every case. In some instances, for a space of thirteen years, after the complete sanitary improvements were made, the saving to the town was estimated to be 25 per cent. in excess of the total cost for the introduction of water and the construction of sewers. It also saves the expense and maintenance of sluices and repair of streets, owing to the flood-wash of storms.

Respectfully submitted,

CHAS. W. KNIGHT, C. E.

Rome, N. Y., October 9th, 1879.

NATIONAL LIBRARY OF MEDICINE
U.S. Department of Health, Education, and Welfare, Public Health Service
Bethesda, Md.

WAA K69s 1880

0014232

NLM 05147360 8

NATIONAL LIBRARY OF MEDICINE